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[54] **COMPACT ELECTROSTATIC COMB ACTUATOR**

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[51] **Int. Cl.**<sup>7</sup> ..... **H02N 1/00**

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[58] **Field of Search** ..... 318/117; 374/176; 376/317; 136/200; 310/309, 308, 40 MM, 12, 313 B

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[57] **ABSTRACT**

A compact electrostatic comb actuator is disclosed for microelectromechanical (MEM) applications. The actuator is based upon a plurality of meshed electrostatic combs, some of which are stationary and others of which are moveable. One or more restoring springs are fabricated within an outline of the electrostatic combs (i.e. superposed with the moveable electrostatic combs) to considerably reduce the space required for the actuator. Additionally, a truss structure is provided to support the moveable electrostatic combs and prevent bending or distortion of these combs due to unbalanced electrostatic forces or external loading. The truss structure formed about the moveable electrostatic combs allows the spacing between the interdigitated fingers of the combs to be reduced to about one micron or less, thereby substantially increasing the number of active fingers which can be provided in a given area. Finally, electrostatic shields can be used in the actuator to substantially reduce unwanted electrostatic fields to further improve performance of the device. As a result, the compact electrostatic comb actuator of the present invention occupies only a fraction of the space required for conventional electrostatic comb actuators, while providing a substantial increase in the available drive force (up to one-hundred times).

**45 Claims, 11 Drawing Sheets**

